## Central Region Science Priority – Water Availability and Use

### Issues/Problems

Questions regarding the availability and use of water in the United States are complex, and not easily solved. Competing demands for water by domestic, industrial, agricultural, recreational, and environmental users, while honoring established water rights, underscore the need for science to help better understand the issues and wisely manage the Nation's water resources. Integrated science and applied technologies are necessary to address knotty issues such as interbasin transfers; dam removal; threatened, endangered, or invasive species remediation; habitat restoration or rehabilitation; or ground-water contamination. In order to better predict the future availability of water, we must improve our understanding of land use and population trends, drought and climate change, and the causes and consequences of changes in water quality and use. Effective water resource studies also require evaluation of global warming and climate variability, management institutions, economic modeling, sophisticated cost-benefit analysis, development of communications strategies, and assessments of public perceptions and attitudes.

USGS Circular 1223 (2002), "Concepts for National Assessment of Water Availability and Use", stated that an assessment should develop and report nationally consistent indicators that would reflect the status and trends in water availability nationwide. Those indicators are (our team added the 'Ecosystem indicators'):

- Surface-water indicators include: Streamflow--annual and periodic (5- to 10-year) summaries, and assessments of long-term trends; Storage in large lakes, perennial snowfields, and glaciers; and Reservoir storage, construction, sedimentation, and removal.
- Ground-water indicators include: Ground-water-level indices for a range of hydrogeologic environments and land-use settings; Changes in ground-water storage due to withdrawals, saltwater intrusion, mine dewatering, and land drainage; and Number and capacity of supply wells and artificial recharge facilities.
- Water-use indicators include: Total withdrawals by source (surface water and ground water) and sector (public supply, domestic, commercial, irrigation, livestock, industrial, mining, thermoelectric power, and hydropower); Reclaimed wastewater; Conveyance losses; and Consumptive uses.
- Ecosystem indicators include: Quantity and quality of fish populations; Fish population sizes and reproductive success; Indices of native versus non-native components of fish community; Indices of riparian community integrity and level of invasive species encroachment; and Channel floodplain connectivity.

The problems associated with availability and use of water in the central United States are complex, and not easily solved without an integrated or interdisciplinary science approach. Each discipline provides data collection, analysis, and interpretation capabilities that are essential to understanding the issues; monitoring the existing quantity, quality, and use; and predicting future conditions.

### Stakeholders

Federal, state, tribal and local governments; land and resource managers; water purveyors including water and sanitation districts; agriculture including farming and livestock, forestry, environmental and special interest groups; individuals; and international concerns. In other words, everyone.

### Opportunities for Integration

Decisions concerning water availability and use must integrate a myriad of factors including surface- and ground-water hydrology, climate, current and projected demand for water (agricultural,

municipal, and recreational), water quality, soils and sedimentation, health of aquatic and riparian communities, invasive species, land use practices, and the social/economic consequences of those decisions. To provide sound scientific support for such decisions requires an integration of information and tools from all USGS disciplines, including surface- and ground-water hydrologic analyses and data, ecosystem studies, land-use and population trends, and geologic mapping and framework studies. Working together, our Disciplines can contribute to a complete understanding of the issues, controlling factors, and potential consequences related to water availability and use, and can provide information and tools for decision-making and resource management.

**USGS Program Goals**

- Future Science Directions: ecosystem health, sustainability, and land-surface change; environmental information science; energy; ground-water resources; invasive species; and rivers.
- REX/PC FY04 Themes: energy and mineral extraction; restoration of ecosystems; invasive species; managing natural systems in face of variability; water quantity, quality, and availability; and rapid response.
- The Fisheries: Aquatic and Endangered Resources (FAER) program – Provide scientific understanding about aquatic animal health, aquatic species and habitats, restoration science, and research technical assistance.
- Geographic Analysis and Monitoring Program—Geographic analysis of the causes and consequences of landscape change over time in order to simulate processes and predict future conditions.
- Land Remote Sensing Program—Derive information from multispectral airborne and satellite imagery in order to better manage natural resources and understand long-term landscape change.
- Research Prospectus—Supports innovative research in geography, cartography, remote sensing, and information science and technology, integrated with interdisciplinary science of interest to the USGS.
- USGS Priority Ecosystem Studies Program—Provide relevant, high-quality, impartial scientific information that permits resource-management agencies to improve the scientific basis for their decisions and to prevent or resolve resource-management conflicts; and to facilitate integration of scientific information.
- Central Region Integrated Science Partnerships—Supports interdisciplinary science of interest to the USGS Central Region.
- Ground Water Resources Program—Assessments of major issues affecting ground-water availability, development of field methods and models, and ground water-level monitoring and information access.
- National Streamflow Information Program—Interstate and international waters information, streamflow forecasts, river basin outflows, sentinel watersheds, and information in support of water-quality networks.
- Cooperative Water Program—Water monitoring, water use information, and water supply assessments.
- Mineral Resources Program – Effects of minerals in rocks and soils on terrestrial and aquatic ecosystem health; examination of contamination of surface- and ground-water from abandoned mine lands; regional and national soil geochemical maps and databases.
- National Cooperative Geologic Mapping Program – Framework geology for ground-water flow models; surficial geologic mapping and material properties characterization for ground-water contamination susceptibility assessments and infiltration modeling.
- Earth Surface Dynamics Program – Effects of large-scale changes in land use and climate on the adequate supplies of clean water; influences and predictability of natural processes and human

activities on the distribution and quality of water; documenting the long-term behavior of hydrologic systems in response to past and recent climatic variations and changes; and studies of the biogeochemistry of greenhouse gases as they affect the global and regional hydrologic cycle.

**Strategy for promoting an interdisciplinary approach**

- Look for opportunities to build upon or package with existing projects.
- Help to develop support for USGS water availability and use initiative.
- Encourage topic-specific and interdisciplinary workshops to build collaborations among scientists.
- Encourage science seminars and details (visiting scientists) between centers and USGS disciplines.
- Conduct a regional overview inventory and gap assessment of aforementioned surface water, ground water, water use, and ecosystem indicators for CR; and report findings.
- Continue to improve internal and external access to data and information from a variety of disciplines and agencies.
- Explore ongoing discipline activities and plans to develop or refine models and decision support systems that describe changes in hydrology, climate change, water quality, and aquatic resources that can be used by decision-makers to evaluate water allocation, reservoir operation, zoning or other land management alternatives; and be an advocate for prioritizing development and interdisciplinary linkages of models and systems.
- Actively participate in CRISP-like funding mechanisms that promote interdisciplinary projects.
- Explore linkages to, and potential expansion of, the USGS Priority Ecosystem Studies Program.
- Encourage development of proposals for Science Impact and Venture Capital call for proposals.
- Develop adaptive management strategies for water use decisions and for aquatic resource restoration.
- Conduct institutional analysis, economic, and human dimensions studies.

**Next Steps**

- FY04 - - Convene Western drought conference; Denver Basin opportunity; Science Impact and Venture Capital call for proposals; begin gap analysis of CR indicators.
- FY05 - - Concentrate on Science Impact call for proposals; assessment of discipline models and systems under development; begin seminars with visiting scientists and plan for holding relevant workshops.
- FY06 - - Look at use of adaptive management strategies; examine inclusion of socio-economic analyses in interdisciplinary studies.